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THE DRAGON-FLY GENUS AGRION (*CALEPTERYX*) IN COLORADO.

By T. D. A. Cockerell,
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The beautiful genus *Calepteryx*, or as it seems we must now call it, *Agrion*, has a curious distribution in North America. Represented by several species in the eastern states, both north and south, it disappears westward of Iowa, to reappear, so far as the records have shown, only in the state of Washington, where *A. æquabile* subspecies *yakima* (Hagen) occurs on the Yakima River. However, on September 30, 1907, Mr. G. Hite took a male at Overland Lake, in the Canadian Zone of Boulder County, Col. This has remained unrecorded, because I repeatedly tried to identify it with one or other of the described forms, always without success. I did not like to propose it as new without seeing a good series of the genus, but now, after comparing it with the materials in the United States National Museum, I can only conclude that it represents a valid new race, as might have been expected.

Agrion æquabile coloradicum Nov.

Male. Structure and colors in the main as in *A. æquabile;* abdomen above rich purple, decidedly bluer than normal *æquabile;* structural characters of abdomen (both the apical and subbasal inferior structures carefully compared) not *quite* as in the *æquabile* compared, but probably not affording anything specific; anterior wing 29.5 mm. long, of which the apical 8 mm. is black; posterior wing 28.5 mm. long, of which the apical 10 mm. is black; in each case the black is quite intense, and has a practically straight inner margin, forming an angle with costa a little greater than a right angle; 24 antenodal cross-nervures in anterior wing, 22–24 in hind wing; costa blue.

As might perhaps have been expected, this appears to be nearest to the subspecies, *yakima*, which agrees in having the inner side of the apical black of the wings practically straight; in this character

both resemble the otherwise quite distinct *A. dimidiatum apicale.* In *yakima,* however, the apical third of the anterior wings is black.

True *A. æquabile,* of which I examined a very long series, is readily separated by the apical black of the wings, which is conspicuously less intense, having its inner side less well defined, and projecting toward the base of the wing in the middle, the shape of the inner margin being roughly that of a broad V. The *hudsonicum* form, which seems weakly characterised, goes with *æquabile.*

Possibly *A. yakima* should be considered a valid species, and *coloradicum* a subspecies of it.

The type of *coloradicum* has been placed in the National Museum.

DIDACTYLOMYIA CAPITATA SP. NOV.

By E. P. Felt,
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The peculiar male described below was collected by Mr. Owen Bryant in August, 1907, either at North Adams, Mass., or on Greylock Mountain. It is closely allied to *D. longimana* from which it is most easily separated by its slightly smaller size, the capitate terminal clasp segment and the relatively longer harpes.

Didactylomyia capitata sp. nov.

Male. Length 1.25 mm. Antennæ probably a little longer than the body, sparsely haired, the stems white, the basal enlargement dark brown; probably fourteen or sixteen segments, the fifth with a stem one-fourth longer than the cylindric basal enlargement, which latter has a length two and one-half times its diameter. Palpi; the first segment irregular, with a length about twice its diameter, the second lanceolate, with a length nearly four times its diameter, the third a little shorter and more slender than the second, the fourth about as long as the third, somewhat dilated. Mesonotum, scutellum and postscutellum mostly reddish brown, the scutellum slightly yellowish apically. Abdomen yellowish, reddish basally. Halteres and legs pale yellowish white. Genitalia; basal and terminal clasp segments both greatly produced, the latter decidedly capitate apically; dorsal plate short, broad, deeply and narrowly incised, the sparse setose lobes narrowly rounded; ventral plate short, broad, broadly and roundly emarginate. Harpes, basal portion broad, obliquely truncate, the inner angles produced as a somewhat irregular, capitate process as long as the basal portion and extending to the tip of the style, which latter is stout, tapering and narrowly rounded. Type Cecid. 1439.

THE ALIMENTARY CANAL OF FLATA AND OTHER HOMOPTERA.

By J. C. Kershaw,
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In many of the Delphacidæ and Fulgoridæ there is a large food-reservoir or crop whose anterior end penetrates the thorax and often enters the head—in *Pyrops* and *Dictyophorodelphax* reaching to the tip of the greatly produced epicranium. In the present subject, *Siphanta acuta* Walker, a Flatid or Pœcillopterid the reservoir is very large and, from its junction with the œsophagus just within the abdomen, extends anteriorly above the œsophagus through the thorax and practically fills the epicranium above the brain. It also extends posteriorly—beneath the heart and above the rest of the internal organs—almost to the tip of the abdomen; when inflated it also spreads out laterally over the other organs, and expands into every available space in the body-cavity, and is then very irregular in contour, becoming much more shapely when contracted or when dissected out of the insect.

In the thoracic portion the reservoir possesses four rather large but often irregularly shaped latero-ventral cæca or pouches (fig. 3, ca), two on either side, which sometimes extend downwards into the coxæ in a manner analogous to the mesenteric cæca of spiders. Anterior to these cæca are two much smaller latero-ventral cæca, one on either side; to the end of each cæcum a slender and rather long muscle is attached, the other end of the muscle attaching to the lateral posterior margin of either side of the prothorax. Occasionally the other cæca also possess slender muscles which attach them to the body-walls, thus serving to anchor the reservoir, but still allowing it plenty of freedom to expand and contract. The reservoir, although tracheæ ramify over it as they do over the rest of the mesenteron, is not moored by them to the body-walls. The tracheæ are not shown in the figures.

This reservoir is an extension of the mesenteron and not of the œsophagus, as appears by the character of its epithelium and its development in the embryo. In the latter (figs. 1 and 2)

the mesenteron, including the reservoir, is completed very shortly —one or two days—before the nymph hatches out; but the œsophagus and salivary glands, the rectum and malpighian tubes are complete several days earlier. The chitinous intima of the œsophagus and rectum is already secreted, though as yet in a plastic condition, at the stage shown in figure 2. The dorsal wall of the midgut and the anterior part of the reservoir are the last portions of the mesenteron to close up and complete. The midgut appears to proliferate from a small mass of cells at the inner ends of the œsophagus and rectum respectively: it appears, therefore, to be of ectodermal origin. The basement-membrane of the mesenteric epithelium is more or less chitinous and apparently secreted by the epithelium itself. The peritoneal membrane is largely developed in this insect (and many other Homoptera, and more or less envelops the whole alimentary canal and its appendages, and appears to be only deficient over the anterior part of the œsophagus, a small posterior portion of the rectum and the long loop (fig. 3, part outside line indicating peritoneal membrane) of the midgut; but it is probable that it is merely exceedingly delicate over this area, and, therefore, practically invisible. In figures 3 and 4, however, the peritoneal membrane is only shown over those parts where it is a really thick tissue, and thus in figure 4a it appears to leave the œsophagus anteriorly and continue only on the reservoir. The posterior part of the œsophagus, the anterior part of the rectum, part of the midgut and reservoir and the proximal portions of the malpighian tubes lie alongside one another in close contact, and are also twisted around each other. The whole tangle is closely invested by the peritoneal membrane; in figure 3 the parts are not shown twisted, in order to keep the figure clear. There is a constriction (fig. 4 frv.) around the reservoir, just in front of the œsophageal valve, provided with extra annular muscles; this occasionally shows as a slight invagination (similar to the œsophageal valve), but in any case it forms a valve for the reservoir, to admit or prevent the passage of food therein.

Berlese supposes (in apparently similar cases of Coccidæ) that by this unusual arrangement of the alimentary canal and its appendages, osmosis of the innutritious watery part of the food and the excess of sugar therein, may take place through the various

parts in contact with the delicate walls of the organs directly into the rectum or posterior part of the gut; thus avoiding passage through the long and tortuous midgut, but leaving the more nourishing matters to take the ordinary course through the whole canal. This would, in fact, be supplementing the action of the peritrophic membrane, whose chief function seems to be that of separating the useless from the useful portions of the food—or rather, retaining the indigestible matter within the membrane till its evacuation from the anus. Certainly the twisted loops of the gut are in intimate contact and their tissues even in part grown together or fused: from which cause this part of the gut is difficult to disentangle without injury. Feeding the insects on colored liquids tends to confirm this theory, since the contents of the long loop of the midgut are very faintly if at all tinted, whilst the rectum is heavily colored.

The epithelium of the reservoir (fig. 4) is formed chiefly by low but very irregular cells, which appear to be in a constant state of degeneration and renewal. In sections from a long series of reservoirs of *Siphanta* during almost every month of the year, there was not one with a moderately perfect epithelium; but one reservoir of *Perkinsiella* was once obtained in very good (apparently resting) condition, out of a long series. The young cells have a single nucleus, but the older ones are mostly bi-nucleated, though very often a cell will have but one enormous nucleus. The epithelium of the cæca is similar but usually in rather more perfect condition, and seems to be constantly renewed by young cells at the bottom or end of the cæca. The cells of the reservoir are in one place or another apparently always secreting; after a time the nuclei become much larger and irregular in shape and the cells become detached from the basement-membrane, or are thrust from it by the new cells. When several contiguous cells become detached they seem to carry with them part of the intercellular cement or membrane, which shows in sections as an irregular reticulum; or it may be the cell-walls persisting longer than the contents. The cast-off cells generally assume a more or less globular form (probably on escaping from the lateral pressure of adjoining cells of the epithelium) and rapidly disintegrate, the nuclei becoming less and less distinct; finally the cells appear to become a granular and somewhat viscid fluid (probably the granules rep-

resent enzymes) and afterwards the viscid matter seems to take part in the formation of the so-called peritrophic membrane. The young nuclei take hæmatoxylin strongly; the secreting upper portion of the cells and the cast-off disintegrating cells tend to stain lightly with acid fuchsin or congo red or picric acid; or else they refuse to stain at all.

The peritrophic membrane seems to be secreted also by the epithelium all along the midgut, although the nuclei of the cells of the œsophageal valve appear different from those of adjoining cells, as if they might be special cells secreting the whole membrane; as concluded by Miall and Hammond in the case of *Chironomus* .[1] But this does not seem probable with regard to *Siphanta*, because certain cells along the whole midgut epithelium can be plainly observed secreting, some of the globules of secretion adhering to and spreading over the outermost layer of the peritrophic membrane. This latter extends from the anterior end of the reservoir through the whole canal to the anus, where it appears to pass out with the rest of the excrement, in a granular or disintegrated condition. The peritrophic membrane is seen in transverse sections (fig. 4B, pm) to be composed very often along some parts of its length of more than one membrane or parts of several non-synchronous secretions, one within another and more or less concentric. It is not very evident how the peritrophic membrane itself can protect the mesenteric epithelium —as it is said to do—by keeping particles of food etc. from contact therewith, since the membrane is very irregular in contour and, when shrunken, comparatively rough, with occasional parts of cell-walls and other matters in its wall not completely digested or dissolved; it is also more or less chitinous. It would appear, rather, that the epithelium of the mesenteron is protected from both food-particles and peritrophic membrane by the layer of viscid fluid mentioned above, which is between the epithelium and the membrane, and which afterwards—in part at least—seems to compose the said membrane. This fluid would tend to keep the latter with its contents fairly in the center of the alimentary canal, even when rounding the numerous sharp bends of the gut. But it may be that only the older internal membranes

[1] The Harlequin fly, Miall and Hammond, 1900.

move endways or disintegrate, passing through the recently-secreted membranes to the rectum, the recent membranes merely being pushed inwards (towards the centre of the canal) by yet more recent membranes.

The reservoir epithelium, tested by litmus in many specimens, invariably gave a very decidedly acid reaction; but the juices of leaves and young stems of *Eucalyptus robusta*, on which the Flatids were feeding, is very acid and immediately reddens blue litmus paper. Probably, therefore, the acidity of the reservoir is due to the food. From the results of feeding several *Siphanta* on rods of pith soaking in red or acid azolitmin, the secretions of the whole alimentary canal appear to be very slightly alkaline, since the contents tended to become more bluish: the epithelium itself does not stain, or not perceptibly. In one specimen fed as above for three days, the contents of the whole gut were faintly red, except the rectum which was strongly blue, with no trace of purple. The chief function of the reservoir seems, on account of its secretive activity, to be digestive. It may also in some way aid in getting rid of the waxy matters which are so abundantly excreted by these insects. It also collects a quantity of air, separated from the food imbibed; there is always some air, often (especially just after the moult to adult) a very large amount. In the many specimens examined there was always some liquid in the reservoir, and sometimes it was nearly full; the contents were well shown by feeding the insects on Sonchus plants growing in water deeply tinged with fuchsin. The liquid food in the alimentary canal always appears to contain a percentage of waxy matter, as does the excrement, although the greater part of the wax in the latter is due to wax-dust from the anal segment wax-glands, which forms a powdery film over the globule of excrement immediately on its evacuation from the anus.

Probably some sugar, and fat in the form of oil, is imbibed with the food and directly assimilated; passing outwards by osmosis through the peritrophic membrane and being absorbed by the cells of the posterior part of the alimentary canal. The digestive matters of the enzymes could also pass inwards through the membrane and convert starch into sugar and peptonise proteids; the products of digestion could then also pass outwards through the membrane, ready for absorption by the cells of the epithelium.

It would seem possible that the diastase of the plant may be imbibed with the rest of the juices, and assist the action of the digestive secretions of the insect. It does not seem probable that the reservoir is a mere store-vessel only, to be drawn upon intermittently. It may perhaps be so spacious in order to give increased area for the digestion and absorption of a comparatively innutritious food, [1] so that it may be rapidly passed on and fresh supplies taken in. On the other hand many Homoptera feeding in like manner on the same plants have no reservoir, though perhaps in these the area of the gut is increased in other directions.

In the nymph just hatched the reservoir does not always enter the head, but soon afterwards it does so, and is completely formed at the time the nymph hatches out. In the head the reservoir lies practically free, but is slightly attached by connective tissue to the front of the head-capsule.

In the nymphs, at each successive moult, there is an almost total and sudden degeneration and disappearance of the epithelium of the alimentary canal, very little remaining but the musculature and peritoneal membrane. The epithelium is then very quickly regenerated.

The muscles of the œsophagus consist of two layers of stout annular fibres crossing each other almost at a right angle (fig. 4). The nuclei of the œsophageal valve are larger than those of the rest of the œsophagus, and rounder than those of the mesenteric epithelium. They probably secrete more actively than the rest of the œsophageal cells, since the six chitinous folds of the intima are much thicker at the valve, forming six cushions or pads at its summit. There seem to be no special glandular cells in the œsophagus, but the salivary-glands and reservoirs in this insect are very voluminous. They give a decidedly alkaline reaction when tested with litmus. Their secretion would probably convert

[1] That it is a somewhat innutritious food compared with that of carnivorous insects may be inferred from the time the insect spends in feeding, and the large amount of excrement continually voided, compared with a carnivorous insect. And besides the fæces must be included as excrement the large quantity of waxy substances excreted from various parts of the body. For although the wax of Homoptera may have become useful in certain ways, such as a covering for their eggs when laid, etc., yet originally it can have had no such use, but was a waste product to be gotten rid of. Yet the phloem of plants contains in the sieve-tubes much proteid matter in the form of a nitrogenous slime, which must be sucked up by the insect along with the rest of its liquid food. Perhaps the Homoptera require such large quantities of food because it is not in a very concentrated form.

much of the starch into sugar before its entrance to the mesenteron, since the secretion is poured out on the hypopharynx, where it mingles with the food, and has then to traverse the pharynx and long œsophagus before entering the mesenteron. The œsophageal valve does not usually lie exactly beneath the reservoir as shown for the sake of clearness in figure 3, but both œsophagus and reservoir twist slightly near the valve, *i. e.*, as soon as they leave the thorax with its mass of muscles and enter the abdomen and have more space, so that the valve and reservoir generally lie somewhat on the right-hand side.

The mesenteric musculature (fig.4) consists of an inner transverse and an outer longitudinal layer of rather slender fibres. In the rectum this disposition of the muscles is reversed.

The four malpighian tubes (fig. 3) for the greater part of their length are plain, rather large diameter tubes, but the short distal portion is of smaller diameter and lobulate, the cells of one side alternating with those of the other. The nuclei of the main portion are more or less globular, those of the distal portion long or oval, but these latter sometimes become very irregular and much branched, probably when actively secreting. This distal part seems to secrete from the blood and excrete into the lumen of the tube a resinous-waxy substance, allied to that of the cuticular wax-glands; it was obtained by boiling several of the distal ends in ether in a small test-tube. The whole tube is at times of a hyaline appearance, of smaller diameter and in color pale yellowish. Generally the main portion is opaque white and often greatly distended for its whole length with urates, calcium oxalate and other waste products, whilst these are not found in the distal portion, which always remains hyaline. The proximal part of the tube, just at its entrance to the gut, somewhat resembles the distal part. The tubes are covered externally by peritoneal membrane, with a few elastic fibres and tracheae; they have a chitinous basement-membrane, apparently secreted by the epithelium which rests upon it; the lumen of the tube is lined by a thick chitinous secretion of the epithelial cells, and has a distinctly striated appearance. When treated with potash and examined under a high power, the intima is seen to be creased or furrowed longitudinally, so that it has the appearance of being formed of six strands fused together spirally—much like a piece of rope.

At times the epithelium also appears transversely striated, *i. e.*, at right angles to the length of the tube; especially in sections or when teased fresh in potash. When the malpighian tubes are swollen with urates, etc., if placed in weak acetic acid the entire contents—urates, intima and epithelium—are quickly evacuated, and the basement and peritoneal-membranes left as an empty shell.

The cells of the epithelium of the tubes seem to disintegrate locally and be replaced by new cells, and frequently (when fully loaded and distended with urates, etc.) the epithelium of long portions of the tubes appears to disintegrate and to fall into the lumen, dissolve and be discharged into the rectum, new cells taking their place. This seems to recur several times during the life of the insect. At all times some of the cells can be seen in sections secreting large globules of matter into the lumen. The distal ends stain much more heavily than the rest of the tube.

The contents of the malpighian tubes give a decided reaction to the murexide test; when the tubes are white and swollen they contain a very large quantity of urates of soda and ammonia in minute roundish granules, appearing to the unaided eye as a whitish sediment; under the microscope they appear white by reflected and pale yellow-brown by transmitted light. By treatment with dilute acetic acid (2 per cent.) very many large colorless crystals and bundles of crystals of uric acid[1] are usually to be seen, which resist the action of hydrochloric acid. Calcium oxalate crystals also occur in numbers, and do not dissolve in water nor in acetic acid, but are entirely dissolved by hydrochloric acid. They may be distinguished microscopically by their form (squarish, with two diagonal lines from corner to corner), and chemically by the decoloring of permanganate of potash added to a solution of the calcium oxalate crystals in sulphuric or hypochloric acid.

Sometimes, on leaving the tubes in water for about twenty-four hours, they are surrounded by a layer of mucilaginous matter which appears to have exuded from the whole of the tubes except the distal ends. Occasionally the tubes are very irregularly swollen here and there into lumps, and are then usually of a bluish hyaline appearance. In this state, which is not common, they

[1] And also what look very like hippuric acid crystals.

seem to contain much waxy matter, and comparatively few urates. But the malpighian tubes require much more study in long series and at all periods from nymph, to adult.

Whilst examining many adults of *Siphanta acuta*, one specimen was found which had one tube completely and perfectly forked distally, just as in *Perkinsiella saccharicida*.

The malpighian tubes of the Homoptera mentioned in this paper are not intricately mixed up with the fat-body and other internal organs, nor so much tied and entangled with tracheæ as in most insects. The distal ends nearly always lie very near the extremity of the abdomen. Occasionally the tubes are connected by the tissue of their distal ends, generally in pairs, but their lumina do not communicate.

The tips of the setæ of *Siphanta* do not appear to penetrate the xylem of vegetation, but it is difficult to kill a specimen so that the setæ are left in the foodplant. The sketch given (fig. 5) was made from a mealybug (*Icerya purchasi*). Several were feeding close together on a young stem of a leguminous tree, and a piece of this was suddenly plunged into benzene, which kills them quickly. Some of the sections made showed the setæ even more twisted than those in the sketch. When the tips of the setæ encounter any hard obstacle they glance aside till they meet another hard spot, again following the least resistance till they reach the layers of tissue next the cambium. Some of the mealybugs had penetrated the cambium, but none had entered (though one or two had touched) the xylem. This might be expected, since all the matters useful as food to the insect are contained in the tissues external to the xylem: the contents of the latter being mere water with mineral salts in solution.

The tissues of the *Eucalyptus* trees on which these Flatids were feeding contain a large quantity of oil and resinous-wax. Some of these substances must be imbibed by the insects, and a great deal of wax (more or less resinous) is excreted by them during their nymphal and adult life. This wax is largely secreted and excreted by anal wax-gland areas, but minute wax-glands are scattered over almost all parts of the insect, even on the head and wings. They are very numerous and rather large on the claval area of the tegmina of *Siphanta*, and they occur on the tip of the epicranium of *Pyrops*. The Membracidæ also have small

wax-glands on the tegmina, and in the nymph they are numerous on the pronotal hood. They occur in most positions where "sensory-organs" also occur, and being also little crater-like processes on the cuticle may sometimes be mistaken for the latter organs.

A fairly large quantity of the wax excreted from the various cuticular glands was collected by boiling the cast skins of nymphs with ether in a Soxhlet extractor, and the following data therefrom were kindly given by Mr. S. S. Peck, chemist at this experiment station,[2] to whom also I am indebted for some tests of the contents of the malpighian tubes given above:

The wax is slightly soluble in alcohol and in ether, easily soluble in benzene. It separates in crystal form. Sp. gr. at 17° = .0972, at 90° = .0826. Melting-point 80°–83.5°.

A quantity of leaves and bark from young stems of Eucalyptus was extracted with benzene in the cold, and the liquid then evaporated, when a fairly thick film of resinous-wax was left on the bottom and sides of the vessel. This residuum was green from contained chlorophyll. The wax appeared to be similar in part to that excreted by the malpighian tubes of the insect, and also by the cuticular wax-glands.

The total length of the adult alimentary canal from the beginning of the œsophagus to the anus is about 35 mm., when not unduly extended.

Siphanta acuta appears to live about two months as an adult. One individual fed well on a young growing Eucalyptus tree, and moulted to adult on April 28, dying on July 1. Another specimen was very near these dates, and both apparently died of old age, the bright coloring having become very dull, in some parts whitish, in others yellow-brown. The vivid yellow-green of young adults becomes a glaucous green in older individuals. Although in the early part of the year the eggs of this Flatid hatch in about twenty days, in the fall they hatch in about ten days.

The three tissues of the midgut—basement-membrane, epithelium and intima—seem homologous with the corresponding tissues of the stomodæum, proctodæum and body-walls. The basement-membrane of the epidermis is chitinous, and that of

[2] Hawaiian Sugar Planters' Experiment Station.

the midgut is also chitinous though very thin. Both epithelia are very similar and secrete a more or less chitinous material from the free ends of the cells, though the somewhat chitinous intima is modified from the highly chitinous secretion of the cuticle. Of the two mesodermic tissues the muscular layer invests the inner wall of the body-cavity and also what is really (if the whole gut is of ectodermic origin) the inner wall of the alimentary canal; the intima of the lumen being its outer or external wall; it also invests the appendages of the gut. The peritoneal layer forms in *Siphanta* an apparently complete investiture of the alimentary canal, though it is in some parts exceedingly thin and barely visible. In the embryo the peritoneal layer seems to originate in close connection with the pericardial and neural septa.

If the midgut is really of ectodermic origin, then that part of the secretion which eventually seems to produce the peritrophic membranes is probably a modification of the secretion which forms the chitinous cuticle. The membranes resist for some time the action of potash: however, the secretion which produces chitin is easily soluble in potash if it is acted upon soon after being secreted and before much exposure to the external air. The secretions of certain colleterial glands also are very soluble in potash when freshly secreted, but soon become almost insoluble, apparently from the action of the external air.

In the Cixiid genus *Oliarus*, at least in the Hawaiian species (fig. 6), the anterior part of the reservoir extends to the head but does not enter it: makes a sharp bend and returns through the thorax to near the abdomen, lying close alongside the posterior part. In the younger nymphal instars the reservoir is not so long, and has no bend and return portion, but this develops before the final moult to adult. The malpighian tubes are forked distally for a great length, the forked portion being lobulate, the rest smooth and of smaller diameter. They are generally of a pale brown.

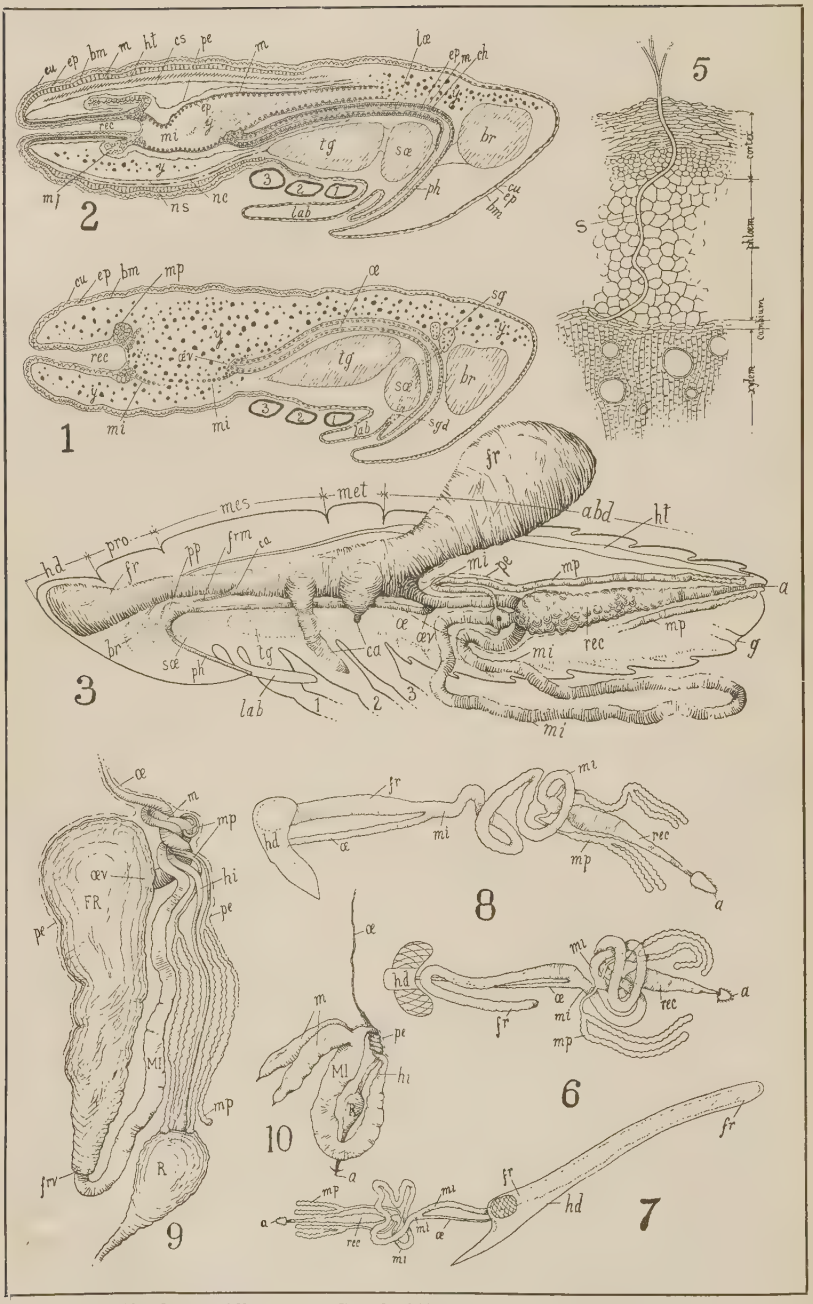
In *Dictyophorodelphax mirabilis* Swezey, an endemic Hawaiian Delphacid (fig. 7), the reservoir enters the headcapsule and continues to the tip of the greatly produced epicranium. The malpighian tubes are forked distally for a moderate length, the forked part being lobulate, the rest smooth. They are of a pale brown.

In *Perkinsiella saccharicida* Kirk., a Delphacid (fig. 8), the

reservoir enters the head. The malpighian tubes are forked distally for a considerable length, the forked and about half the single portion being lobulate, the rest smooth. The color varies from pale pink to dark purple-red.

In the family Membracidæ the alimentary canal (fig. 9) differs in arrangement from the foregoing insects. The anterior part of the reservoir only projects slightly into the thorax: posteriorly it extends to near the extremity of the abdomen as a sac of large diameter, though gradually narrowing to the reservoir-valve. The posterior part of the œsophagus, together with portions of the midgut and proximal parts of the malpighian tubes are wound or twisted together, so that it is very difficult to disentangle without injuring them, especially as their tissues where in contact coalesce, and the whole mass or knot is invested by peritoneal membrane. The malpighian tubes are forked, the fork extending to somewhat near their point of origin. They originate as two tubes, each of which afterwards forks and together form the usual four tubes. The proximal single portions are smooth, the rest lobulated. Often the mid-part of the tubes is much swollen for a considerable length by urates, etc., and this portion is then of an opaque white. Otherwise their color is pale brownish or yellowish. The distal ends generally abut on the rectum, into which they usually bulge somewhat. In other cases the distal ends are sometimes united in pairs, but their lumina do not communicate.

Of the family Aleyrodidœ, *Aleyrodes, sonchi* Kotinsky, a native of the Hawaiian islands (fig. 10), has no reservoir. The œsophagus is very long and slender, and the posterior portion of it, together with the anterior part of the hind intestine are twisted around each other for some distance, and apparently enclosed with a peritrophic membrane. The malpighian tubes are two in number and very large; they appear to be always more or less clear or hyaline and colorless. Besides uric acid there appeared to be hippuric acid crystals in the tubes. The junction of the midgut and hind intestine (where the malpighian tubes originate) is right up at the anterior end of the abdomen, near the base of the œsophagus, when the gut lies in its natural position in the abdomen. The tegimina and wings of this insect are white from the wax excreted from the numberless tiny glands thereon.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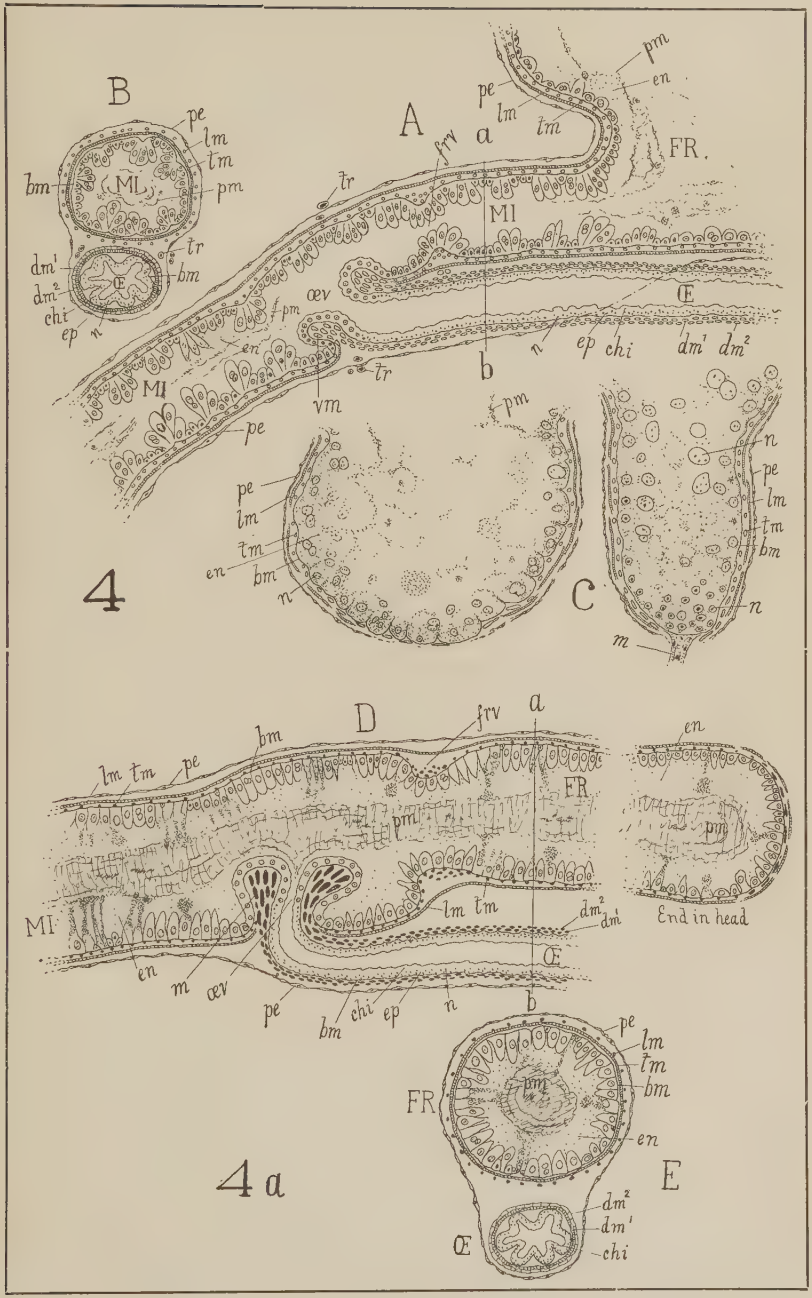
Kershaw—Alimentary Canal of Flata and Other Homoptera.



Kershaw—Alimentary Canal of Flata and Other Homoptera.

In conclusion, I am indebted to Dr. H. Lyon, the pathologist of this experiment station, for much information about the plants on which these insects feed, especially with regard to the nature of the vegetable juices which they imbibe.

EXPLANATION OF FIGURES.

1. Early embryo of *Siphanta acuta*. Fam. Flatidæ.
2. Later embryo of the same.
3. Alimentary canal of the same.
4. Details of the same.
   A = longitudinal section of mesenteron and œsophagus.
   B = transverse section of same, through line a—b
   C = longitudinal sections of ceaca of reservoir.

4a:

   D = longitudinal section of mesenteron and œsophagus of *Perkinsiella saccharicida*.
   E = transverse section of same, through line a—b.

5. Transverse section of young stem of plant, showing setæ of a mealybug amongst tissues.
6. Alimentary canal of *Oliarus* sp. Fam. Cixiidæ.
7. Alimentary canal of *Dictyophorodelphax mirabilis* Sw., Fam. Delphacidæ.
8. Alimentary canal of *Perkinsiella saccharicida* Kirk., Fam. Delphacidæ.
9. Alimentary canal of *Tricentrus albomaculatus* Dist., Fam. Membracidæ.
10. Alimentary canal of *Aleyrodes sonchi* Kot., Fam. Aleyrodidæ.

In all the figures of the alimentary canal the parts are more or less opened out, so as to show clearly.

LETTERING OF FIGURES.

a = anus.
abd = abdomen.
bm = basement-membrane.
br = brain.
ca = cæcum.
chi = chitinous intima.
cs = cardiac septum.
cu = cuticle.
dm^1 = inner diagonal muscles of œsophagus.
dm^2 = outer diagonal muscles of œsophagus.
en = viscid fluid between epithelium and peritrophic membrane, probably containing the enzymes; only shown in the figures in two or three places, to keep them clear; except in figure 4a.
ep = epithelium.
fr = food-reservoir.
frm = food-reservoir muscles.
frv = food-reservoir valve.
g = genital opening.
hd = head.
hi = hind intestine.
ht = heart.
lab = labium.
lm = longitudinal muscles.
lœ = lumen of œsophagus.
m = muscles.
mes = mesothorax.
met = metathorax.
mi = mid-intestine (midgut, mesenteron).
mp = malpighian tubes.

n = nucleus.
nc = nerve-cord.
ns = neural septum.
œ = œsophagus.
œv = œsophageal valve.
pe = peritoneal membrane.
ph = pharynx.
pm = peritrophic membrane.
pp = pharyngeal pump.
pro = prothorax.
R, rec = rectum.
s = setæ.
sg = salivary glands.
sgd = salivary gland duct.
sœ = subœsophageal ganglion.
tg = thoracic ganglion.
tm = transverse muscles.
tr = trachea.
vm = valve muscles.
y = yolk.
1, 2, 3 = coxæ.

ON THE EARLY STAGES OF SOME WESTERN CATOCALA SPECIES.

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Decatur, Ill.

It was our good fortune in the autumn of 1912 to obtain ova of several species of *Catocala* whose early stages had never been studied. Most of these we successfully bred through to the adult stage; colored figures of the larvæ have been made and will be published later in connection with Beutenmüller's Monograph of the Genus Catocala, which we have been asked by the trustees of the American Museum to revise and complete for publication; in the meantime we offer the following notes on the larval stages. The species in question may be roughly divided into two groups—the oak feeders, comprising *zoe*, *aholibah*, *ophelia*, *beutenmuelleri*, and *desdemona*, and the willow and poplar feeders consisting of *faustina*, *californica*, *irene*, *pura*, and the species going under the name of *aspasia* Strecker. These two groups may be readily separated in the first larval stage by the fact that the setæ arising from the primary tubercles are much longer in the oak feeders than in the willow and poplar feeders, giving the former under a lense quite a spiny appearance, whereas the latter appear almost smooth. Among themselves the larvæ of each group are very similar in the first stage; the oak feeders are of a bluish-gray color with more or less strongly developed deep brown lateral blotches on the first four abdominal segments, 5–6 brown lateral lines and at times a similar centro-dorsal line; the presence of this dorsal

line in Stage 1 separates *zoe* and *aholibah* from the other three species; these two may be distinguished from each other, apart from the ova, which are very dissimilar, by the fact that the brown lateral blotches in *aholibah* tend to form more or less evident transverse banding and the two spiracular lateral lines are more broken than in *zoe;* in later stages the two species diverge widely from each other. Of the other three *desdemona* is distinguished by possessing 6 lateral brown lines in Stage 1 instead of 5 as in *beutenmuelleri* and *ophelia;* of these latter two species *ophelia* shows two subdorsal lines in Stage I which are not developed in *beutenmuelleri* until Stage II. In the later stages of all these species the spaces between these brown lines gradually become paler than the ground color, forming stripes to which the lines act as a border, becoming more wavy in character and finally breaking up into a series of dots scarcely to be distinguished from the general surface of the body which is strongly sprinkled with similar dots; the dorsal stripe with its characteristic diamond-shaped enlargements on the abdominal segments appears usually in Stage II, either as pale irregular bordering to the centro-dorsal line, or failing this line as a pale stripe between the two subdorsal lines, in which case the centro-dorsal line makes its appearance later.

The willow and poplar feeders bear still more resemblance to each other than the oak group and are almost indistinguishable from one another in Stage I. All have a reddish-brown head and a pale greenish body shading into purplish or blackish laterally, this darker portion crossed by three pale rather waved lines; *aspasia* is the palest, and is almost entirely whitish-green with only faint traces of the lines; *calijornica* is the darkest, being laterally almost black in Stage II; the others are intermediate. The development of the maculation is the direct antithesis of that found in the oak-feeders; the stripes develop directly from the pale lines of Stage I, the darker bordering lines (the only ones visible in the 1st stage of the oak-feeders) appearing only in the 2nd or 3rd stages.

We append a more detailed description of the various stages:—

Catocala zoe Behr.

Ovum. Large, echinus-shaped, liver-brown with irregular ring of yellow around widest part; strongly ribbed, about 16 ribs diverging from the micropylar area and branching into 2 or 3 almost immediately, these ribs crossed at right angles by

very fine ribbing; micropylar area a rosette of minute cells. Width, 1.5 mm. Height, .8 mm.

Stage I. Head flat, black; body blue-gray; a dark dorsal line; a lateral band paler than the ground color, bordered on each side by a fine dark line and containing a similar central line; two further dark subspiracular lines; on abdominal segments I–IV small round deep brown patches laterally; primary tubercles black, prominent especially those situated ventrad to the pale lateral stripe, each with a long black seta Beneath pale gray with central dark blotches. Length, 6 mm. Width of head, .5 mm.

Stage II. Head whitish, strongly marbled with black, with two black lines in front, bending away from each other as they approach apex of cheeks, a central dark line in clypeus and a curved line around lateral portion of the cheeks; body gray with dark brown dorsal line irregularly bordered with whitish, this color tending to spread out into diamond-shaped patches towards rear of each segment and defined outwardly by a blackish line; lateral whitish band as before with dark borders and central line; below this a black line on a level with tubercle IV; a 5th subspiracular line bordered dorsally with whitish; dark blotches on abdominal segments 1-4 as in previous stage; tubercles large, black, increasing in size towards posterior end; prolegs with a strong black chitinous lateral plate. Beneath whitish with dark central blotches. Length, 12 mm.

Stage III. Head as in previous stage; on the body the light stripes of the previous stage have so broadened that the general ground color appears light gray slightly mottled with flesh color, the darker portion being confined to a subdorsal irregular band and a similar lateral band in the region of tubercle III; a light gray, very irregular dorsal band defined outwardly by black lines and broadening into diamond patches at the rear of each segment with a dark centro-dorsal line; the subdorsal dark areas are more or less shaded with gray anterior to tubercle II; lateral gray area and dark lines as before; ventrad to this is the lateral dark area on a level with tubercle IV, paler on thoracic segments, with mere traces of dark lateral patches of previous stages, bounded ventrally by dark line; the light area ventrad to this contains two dark lines, the lower forming the outer margin; dorsal tubercles conical, shaded black and white, especially large on 8th abdominal segment; a small transverse dark wart dorsally on 5th abdominal segment. Beneath whitish with black central patches. Length, 18 mm.

Stage IV. Head gray strongly striate with black; a black upright dash in central front portion of cheek and a broad curved lateral line of same color; body pale gray, marbled, rough and tubercular in appearance; markings essentially as in preceding stage; the pale gray dorsal stripe with diamond-shaped enlargements is usually quite prominent owing to its being bordered by a darker gray subdorsal stripe, deepest in color on the 1st, 2nd and 5th abdominal segments; dark suprapiracular stripe distinct, paler in anterior portion and on 4th abdominal segment; dorsal tubercles pale, ochreous, raised, with more or less of a transverse ridge between the two tubercles II, especially marked on 1st, 2nd, 5th and 8th abdominal segments; on 5th abdominal segment a small dark transverse dorsal wart, shaded posteriorly with blackish; tubercle II on 8th abdominal segment large and conical; tubercle IV situated on a rather raised wart just behind spiracle; below

this a dark line in a paler field is distinguishable. Beneath pinkish white with the usual dark blotches. Length, 30 mm.

Stage V. Head pale ochreous, the upper portion of the lobes tinged with orange, marbled with dark purple-gray with black lateral line descending as far as the ocelli; slight central black line to clypeus. Body very warty both dorsally and laterally, with deep lateral indentations above and below the spiracular area, pale gray, marbled with olive brown, maculation quite similar to that of the preceding stage; dorsal stripe pale gray, irregular, broadening at rear of each segment into diamond-patches which are tinged with ochreous on abdominal segments 1-4; subdorsal stripe dark brownish, broad, waved, prominent behind tubercle II on abdominal segments 1–3, 5 and 8, paler and more diffuse on the other segments; dark spiracular stripe, paler on the thoracic segments, abdominal segment 4, the anterior portion of 5 and posterior portion of 6; abdominal segments more or less humped dorsally between tubercules II, most so on 5 and 8; tubercles situated on a raised hump, tinged with ochreous. Lateral filaments whitish. Beneath deep purple-pink with blackish central patches. Length mature, 40 mm.

Food-plant: Buds and catkins of burr-oak.

The young larvæ emerge with the first warmth of spring, all the ova hatching within a short period of each other; the growth is very rapid, maturity being reached in less than a month; the pupal stage is about three weeks.

The species is very easy to raise, the critical period being just before attaining full growth, when the larvæ seem liable to intestinal troubles which are apparently more or less contagious. In our brood there was also a noticeable difficulty in properly shedding the larval skin in transforming into the pupa.

Catocala aholibah Stkr.

Ovum. Dark dirty green, surface of egg strongly granulate but without ribs; micropylar area scarcely visible as a rosette of minute hexagonal cells. Diameter, 2 mm.

Stage I. Head deep brown, prothoracic plate black; body bluish-gray with brown dorsal line, three brown lateral lines of which the middle one is most distinct; two similar subspiracular lines the upper one rather curved and much broken; abdominal segments 1–4 crossed by broken broad transverse brownish bands, heaviest laterally; tubercles large, black, with long setæ. Beneath pale with central dark blotches. Length, 6 mm.

Stage II. Head pale brown, strongly veined with black-brown, forming a line on each side arising from the mouth and curving outwards and upwards, broadest towards apex of lobes; central dark line to clypeus; body pale brown, slightly banded with brown on abdominal segments as before; a brown dorsal line broadening slightly towards rear of each segment and irregularly bordered with creamy, forming more or less distinct diamond-shaped patches as usual; two pale slightly

waved lateral lines and a third subspiracular one, much curved; tubercles large, black; slight dorsal transverse wart on the 5th abdominal segment and more prominent conical protuberance on dorsal portion of 8th; prolegs pale with black stripes. Beneath whitish with prominent black patches. Length, 10 mm.

Stage III. Head pale, strongly lined with black, apex of lobes tipped with orange behind which is a heavy black curved line; body gray-purple with distinct black tubercles which at times are orange-tipped; a prominent transverse blackish wart on 5th abdominal segment and a conical protuberance tipped by tubercle II on 8th; similar lesser prominence on the 9th; lines and stripes as in preceding stage but broader and less distinct; lateral black shading below transverse wart of 5th abdominal segment. Length. 18 mm.

Stage IV. Head pale creamy strongly lined with black in front and with apex of lobes tipped with orange behind which is heavy black marking. Body purple-brown, the 1st abdominal segment with pale creamy suffusion between and lateral to tubercles I and II, often very faint; stripes of previous stage not distinguishable but the black border lines have broken up into a series of irregular dotted lines on a more or less whitish ground, giving a general mottled appearance; tubercles orange, tipped with black and ringed at base with white, the black color often predominating; transverse wart of 5th abdominal segment black, tipped with white at apex and defined laterally by the orange tubercles II; laterally to this is more or less oblique dark suffusion; prominent hump on 8th abdominal segment tipped by large conical tubercles II, orange in front, black posteriorly. Beneath whitish with black central blotches. Length, 30 mm.

Stage V. Head pale ochreous, pitted, marbled with purplish gray with tips of lobes tinged with umber-brown, beneath which is a blackish dot and behind which on the dorsal portion of the lobe is a broad black stripe slightly curved at each end but not descending downwards below the level of the umber-brown area. Body pale liver-brown with numerous black dots encircled with white the remnant of the lines of earlier stages; tubercles coral or deep brown ringed at base with white; transverse wart of 5th abdominal segment whitish strongly marbled with black; 6th and 7th abdominal segments laterally and posteriorly slightly discolored with brownish; 8th abdominal segment with strong dorsal hump on which are situated tubercles II, large, conical, directed backwards, umber tipped with black; spiracles situated in pale area, black-rimmed; legs pink, shields of prolegs, prothoracic and anal plates ochreous; filaments white; first abdominal segment between tubercle II and spiracle slightly paler, the remains of the patch of the previous stage. Beneath white with black and brown central blotches. Length, 60 mm.

Food-plant: Buds and catkins of burr-oak.

The emergence and habits of the young larvæ coincide with those of *zoe;* in all its stages the species shows a close resemblance to *sponsa* of Europe. Ova from Truckee, Calif. and Provo, Utah gave rise to similar larvæ, the resulting imagines being also identical except that the Utah specimens were generally larger. About 1-4 of the Utah larvæ gave the form *coloradensis* Beut. which is a

mere aberration in which the primaries are distinctly paler and the brown band beyond the t. p. line more marked in consequence.

Catocala beutenmuelleri B. & McD.

Ovum. Flat, strongly ribbed; micropylar area forms a slightly raised button with central depression containing the micropyle itself; from the rim of this area 17–20 broad unbranched ribs arise, crossed at right angles by numerous fine wavy cross-ribs. Color purple with yellow ring a short distance above the base. Diameter, 1 mm.

Stage I. Head black. Body pale gray with 3 brown lateral stripes; diffuse brown patches laterally on 1st four abdominal segments with traces of a 4th brown line posterior to them; below these a 5th subspiracular line; tubercles black, small, with long setæ. Beneath pale with central dark blotches. Length, 4 mm.

Stage II. Head pale gray, heavily mottled with brown except in front and with two heavy dark curved lines below apex of lobes not reaching lower than apex of clypeus; five equidistant lateral and subspiracular lines as before, the 3rd line rather waved, the lower line distinct; dark lateral abdominal patches much fainter than in preceding stage; dorsal region with two brown lines narrowing between tubercles I and spreading out towards rear of segments tending to form diamond-shaped patches of the enclosed space; traces of a centro-dorsal line between tubercles I on abdominal segments; on 5th abdominal segment a slight raised dorsal wart; on 8th abdominal a small conical projection; tubercles black with setæ as before. Length, 9 mm.

Stage III. Head as before but more striate with black. Body and markings essentially as before but pale dorsal diamond-shaped patches more noticeable and the dark lines appearing more as border lines to enclosed yellowish stripes; small transverse wart on 5th abdominal segment; the rear portion of this segment and anterior portion of 6th shaded with blackish; 8th segment raised dorsally with conical reddish tubercles and a small black lunate mark posterior to these; prolegs with black stripe. Length, 15 mm.

Stage IV. Head pale, strongly marbled, apex of lobes slightly orange, below which is a small blackish curved mark; behind the apex of lobes a curved double black line extending laterally down the sides of the cheeks. Body gray, somewhat ochreous at the incisions of the first four abdominal segments; lines and stripes much as before but fainter, the former being broken up into a series of dots; tubercle on 5th abdominal segment black, prominent, with dirty brown oblique patch extending laterally downwards to base of prolegs; tubercles deep orange, those on 8th abdominal segment situated on a strong hump behind which is a curved orange mark; prolegs pale, striped with black; beneath whitish with the usual black patches. Length, 25 mm.

Stage V. Head purplish gray marbled in the front of the lobes with darker; the two tubercles at the apex of the lobes tipped with orange with dark blackish curved mark behind the apex. Body light gray, fairly smooth, with small oblique ridges on the anterior abdominal segments extending laterally forward from tubercle II; pale dorsal stripe with diamond-shaped enlargements; remainder of body heavily marbled with black dots, representing the dark border lines of previous

stages; a very prominent fleshy beak-like wart on 5th abdominal segment shaded with black and with black posterior markings extending obliquely downward over the anterior portion of the following segment; laterally the 5th segment is shaded with light brown extending between the prolegs on to the 6th segment; prominent conical dorsal tubercles on the 8th abdominal segment with lunate brown mark behind extending to above spiracle; filaments whitish; beneath white with central black blotches. Length, 40 mm.

Food-plant: Buds and catkins of oak.

The larvæ emerged about a week later than *zoe* and *aholibah* maturing rather more slowly than these two species; a number of the full grown larvæ refused to pupate but gradually shrivelled up and died; it is probable that better results would be obtained by isolating the larvæ in the last stage. The prominent dorsal wart on the fifth abdominal segment would place the species in the *ultronia* group. In our opinion *beutenmuelleri* will prove to be a local race of *verrilliana* but we can find no larval description of this species. We cannot agree with Hampson who makes this species and *werneri* Bied. synonymous; this latter species, of which the type is in Coll. Barnes, shows much more affinity to *violenta* Edw. and we should not be surprised if it proved to be a mere aberrant form of the same; *ophelia* Hy. Edw. we have proved by breeding to be a species very distinct from *beutenmuelleri* and presumably therefore from *verrilliana;* breeding alone will show how closely it is related to *violenta* Edw.

Catocala ophelia Edw.

Ovum. Hemispherical, much higher than *beutenmuelleri;* ribbed, about 20 ribs attaining the edge of the raised circular micropylar area, every second rib branching dicotomously in contradistinction to the preceding species where the ribs always remain single; color liver-brown with yellow ring near the base. Diameter, 1.2 mm.

Stage I. Head blackish; body blue-gray more or less completely banded with brown on the first four abdominal segments, tending to form lateral and dorsal blotches; tubercles black with long black setæ; geminate rather waved dorsal brown lines situated in the area between tubercles I and II and tending to separate towards rear of each segment; three lateral brown lines and two further subspiracular ones. Beneath whitish with brown central patches. Length, 6 mm.

Stage II. Head pale gray, marbled with black with inverted V shaped black mark on front of each lobe and central black dash on clypeus. Body pale yellowish gray with black tubercles and traces of lateral purplish patches of previous stage; markings as before with the addition of a centro-dorsal broken stripe, thickened slightly at intervals. Length, 11 mm.

Stage III. Head same as before. The lines on the body of the previous stage

now appear as border lines to three pale ochreous stripes; dorsal stripe broadening to the usual diamond shaped patches and with central dark line, thickening in these same patches; small dark transverse tubercle on 5th abdominal segment; dorsal protuberance on the 8th abdominal segment with large conical flesh-colored tubercles; 9th segment similar but smaller. Length, 18 mm.

Stage IV. Head pale with V mark and central dash as before; apex of lobes tinged with orange; cheeks bordered by a double black curved line. Body pale gray, the markings essentially as before but fainter, the black border-lines broken up into dots, the lateral stripes most marked between prolegs of 5th and 6th abdominal segments, the ground color being here somewhat darker; dorsal wart on 5th abdominal segment small, shaded with blackish; tubercles orange, II on the 8th abdominal segment large, extended backward and situated on a prominence. Beneath white with black central patches. Length, 30 mm.

Stage V. Head pale purple-gray, apex of lobes white, slightly lined with orange-red and purple, the white color extending down cheeks frontally in irregular lines; a black lateral border line to cheeks shaded inwardly with orange. Body deep gray, smooth, heavily dotted with black; stripes of the previous stages fairly distinct; tubercles small, brick-red, tubercle II on 8th abdominal segment large, situated on prominence; wart on 5th abdominal segment small dusky; an ochreous subspiracular stripe between prolegs of 5th and 6th abdominal segments, shaded dorsally with deep smoky gray; filaments whitish. Beneath white with the usual dark central patches. Length, 40 mm.

Food-plant: Buds and catkins of burr-oak.

The species may at once be separated from the preceding by the lack of the prominent hump on the 5th abdominal segment and the presence of an ochreous patch between prolegs of 5th and 6th abdominal segments. It coincides with *beutenmuelleri* in its general habits. The parent moth was captured at Provo, Utah.

Catocala desdemona Edw.

Ovum. Pale yellowish, very finely ribbed with numerous branching ribs, hemispherical; micropylar area slightly raised, circular.

Stage I. Head brownish; body pale gray with fairly large black tubercles and brown lateral patches on abdominal segments 1–4 tending to broaden into transverse bands; three brown lateral lines and traces of three further lines below these the upper two of which are only visible behind the lateral brown patches. Beneath pale with central brown blotches. Length, 6 mm.

Stage II. Head gray with curved black line in frontal portion of cheek curving outward toward apex of lobes; central black line on clypeus. Body gray with pale germinate dorsal stripes bordered with dark brown and tending to coalesce; two pale lateral stripes similarly bordered; a third subspiracular one; a faint brown line defines the pale ventral area; traces of the dark lateral patches still present. Length, 13 mm.

Stage III. Head pale gray slightly tipped with orange; dark W mark in frontal

portion of cheeks and dark curved lateral border to same; clypeus with central dark line. Body pale gray; dorsal and three lateral creamy stripes prominent, bordered by brown lines; 5th abdominal segment with small dorsal wart tipped with reddish at apex; from this wart a dusky lateral shade extends downward to the prolegs, crossed by the pale lateral stripes; tubercles reddish, tubercle II of 8th abdominal segment conical, with dark lunate reddish line posterior to it; prolegs striped with black. Length, 18 mm.

Stage IV. Head gray, apex of lobes tinged with orange-red; lobes strongly marbled vertically forming W mark frontally; geminate lateral black curved line and central line to clypeus. Body gray with paler creamy stripes; dorsal stripe, as usual, tending to diamond-shaped enlargements, with centro-dorsal dark line and similar colored border-line, most prominent at rear of 1st four abdominal segments; three pale lateral stripes bordered with blackish lines which tend to break up into dots; on 1st abdominal segment a dark oblique lateral shade extends forward from tubercle II toward the 3rd pair of legs; dorsal wart on 5th abdominal segment flesh-colored with diffuse darkish shade extending from it laterally to prolegs; tubercles orange; curved line behind the conical dorsal tubercles on 8th abdominal segment brownish. Beneath whitish with the usual dark blotches. Length, 20–30 mm.

Stage V. Head whitish tinged with orange in front and along sides of cheeks; pale purple gray marbling in front forming a W mark, black border stripe to cheeks laterally. Body pale to dark gray caused by numerous dark dots on a whitish ground; dorsal and lateral stripes of previous stage distinct, latter waved and irregular, the dark border lines broken up into dots, most distinct behind tubercle II on first 5 abdominal segments as lower border of the dorsal stripe and upper border of the first lateral one; on first abdominal segment an oblique pale shade running from tubercle II to beyond spiracle and bordered posteriorly slightly with dark gray; wart on 5th abdominal segment fairly large, tipped with white, with brown marbling at base, lateral to this wart an oblique brownish shade crossed by the pale stripes and with the ground color showing on a level with the spiracle as a dark gray cross-stripe; reddish lunate dorsal line on 8th abdominal segment posterior to the large conical tubercles II; tubercles orange with white base; prolegs pinkish marbled with brown; filaments white. Beneath white shaded with pink with the usual dark central blotches. Length, 50 mm.

Food-plant: Buds and catkins of burr-oak.

This species was the latest of the oak-feeders to emerge; after reaching its full size the larvæ seem to find difficulty in pupating, a number of ours dying at this stage. The larva is considerably larger and more variegated than that of either *ophelia* or *beutenmuelleri*.

Catocala pura Hlst.

Ovum. Hemispherical, deep purplish-red banded with yellowish near base, ribbed, the ribs branching into two or three shortly after leaving micropylar area

which is slightly raised. Very similar to the egg of *C. faustina*. Diameter, 1.25 mm.

Stage I. Head red-brown. Body when first emerged blackish, later dirty green shaded with purplish anteriorly and posteriorly, with three pale lateral lines; tubercles small, black, with short setæ. Beneath paler with faint central dark blotches. Length, 5–6 mm.

Stage II. Head pale creamy, cheeks slightly marbled with light brown; body light brown, the three pale lines have broadened into waved stripes bordered with darker lines; a pale dorsal stripe, expanding more or less into diamond patches and with trace of centro-dorsal line; 5th abdominal segment with slight transverse black wart from sides of which an oblique black patch extends backward and downward to just above the prolegs of 6th segment; a lunate dorsal black line on 8th abdominal segment the dorsal tubercles of which are slightly raised and conical; all other tubercles very minute; prolegs pale. Length, 15 mm.

Stage III. Head creamy tinged with orange below the apices of the lobes, pale brown frontal marbling, two lateral deep brown lines on the cheeks. Body pale gray-green, having a general marbled appearance; marking essentially as in previous stage, the pale stripes however are scarcely distinguishable and the brown border lines appear prominent, giving the appearance of 7 waved lateral lines and a similar dorsal one; rear portion of 5th abdominal segment velvety-black, this color extending obliquely downwards to prolegs of 5th and 6th segments; a small dorsal wart tinged with orange situated in this black area; tubercles pale orange, tubercle II on 7th abdominal segment tinged posteriorly with black, on 8th with a black lunate dorsal mark, slightly broken in the center posterior to this tubercle. Length, 25 mm.

Stage IV. Head creamy, apical portion of lobes orange below which is pale brown marbling, cheeks with dark curved border-line. Body pale gray-white, the blackish border-lines resolved into dots giving a general marbled appearance; transverse orange wart on 5th abdominal segment with the black shading of the previous stage less pronounced, only traces of this color being visible above the prolegs; tubercles orange, tubercles II on 8th and 9th abdominal segments being situated on conical prominences, the former the larger; lunate black mark on 8th as before but unbroken; dorsal diamond patches on abdominal segments shaded with pale orange-brown. Length, 30 mm.

Stage V. Head pale gray; apical portion of lobes with rather prominent tubercle shaded broadly with orange; purplish marbling and black lateral border as before. Body round and smooth, pale whitish gray, heavily sprinkled with black dots which tend to form wavy longitudinal lines; pale dorsal diamond patches faintly visible, slightly tinged with ochreous; prominent reddish ochreous hump on 5th abdominal segment at times with traces of the black lateral shading of former stages, often entirely without this; lunate mark of 8th abdominal segment less distinct than before, tubercle II prominent, conical; legs flesh-colored; filaments grayish. Beneath white with the usual dark central patches. Length, 60 mm.

Food-plant: Poplar.

The ova start hatching soon after the first warm weather in spring the period of emergence extending over several weeks.

We were very successful with this species and secured a long series of moths; two forms were represented in about equal numbers—the typical one with black shade extending nearly the whole length of wing above inner margin and a form in which this shade was lacking, the wing being more even gray; both these forms were the offspring of a single ♀.

Catocala aspasia Stkr.

Ovum. Liver-brown, micropyle and broad irregular ring at upper part of egg pale greenish yellow; ribbed but not very strongly, the ribs dividing below micropylar area into about 30–40. Diameter, 1 mm.

Stage I. Head pale brown; body pale greenish white, semitransparent, shading slightly into reddish laterally with traces of three pale lateral lines; tubercles very minute with small setæ. Length, 5 mm.

Stage II. Head creamy, slightly marbled with pale brown; body whitish, slightly green tinted, an irregularly broadening dorsal stripe and three lateral ones are visible largely due to the pale brown linear borders; a faint trace of brownish lateral shading on 5th abdominal segment, prolegs concolorous. Beneath pale with dark central patches. Length, 12 mm.

Stage III. Much as before; head shaded slightly with pale yellow at apex of lobes; body with stripes less visible and bordering lines broken up into dots, giving a general marbled appearance; very small wart on 5th abdominal segment, slightly yellow, with still fainter traces of lateral black shading; tubercle II on rear segments slightly yellow with traces of a lunate dorsal black mark on the 8th abdominal segment as found in *pura*. Length, 20 mm.

Stage IV. Head whitish, clypeus slightly marked with pale brown, apex of lobe tinged with yellow-orange below which is brownish marbling of which a dash on a level with side of clypeus is most prominent; black border line to cheeks extending to eyes and not very clearly defined on the summit of the head. Body whitish gray with much clearer markings than before; dorsal series of pale diamond patches with central brown line; subdorsally two waved black dotted lines the upper one forming border to diamond-patches, the lower one on a level with tubercle III, most prominent toward the rear of each segment giving a distinctly blackish appearance; laterally the body surface is thickly covered with black and brown dots formed into more or less parallel lines, the enclosed spaces being slightly tinged with lemon yellow; prominent yellowish hump on 5th abdominal segment at times slightly shaded with black laterally but mostly without this; small blackish dorsal lunate mark on 8th abdominal segment; dorsal tubercles yellowish, tubercle II on rear segments not very prominent; prolegs tinged with pinkish. Beneath white. Length, 35 mm.

Stage V. Head creamy, clypeus with two vertical purple-black dashes; apex of lobe strongly tuberculate, orange; black border laterally to cheeks extending from palpi upwards, not clearly defined on summit of head; purplish marbling in front forming small patch below the orange tubercle and a vertical dash opposite clypeus. Body varying from pale ochreous to pale brown, sprinkled with deeper

colored dots, usually with subdorsal blackish band formed of numerous spots defining the pale diamond shaped patches, most accentuated behind tubercle II; a similar but less distinct spiracular band; tubercles yellow-ochre, small; wart on 5th abdominal segment not prominent, tinged with ochreous; vague traces of a black dorsal lunate mark on 8th abdominal segment; tubercle II on this segment not much larger than on preceding segment; legs and prolegs pale tinged with pinkish; spiracles ochreous ringed with black, filaments pale. Beneath whitish with the ordinary black blotches. Length, 45 mm.

Food-plant: Poplar.

The larva emerges somewhat later than *pura;* we brought a number of larvæ to maturity but they all failed to pupate and gradually shrivelled and died. Strecker's *aspasia* was described from Lower California and we are in doubt whether the name will apply to the form found in Utah and Colorado which commonly goes under the name *aspasia.* The larvæ in Stage III show great similarity with the final stage of *pura,* but in their maturity apparently approach closest to *parta.*

Catocala faustina Stkr.

Ovum. Echinus-shaped; deep purple-brown with blotches of pale greenish apically and a narrow central band of similar color; micropylar area arising from slight depression at apex of egg, irregularly circular, formed of minute cells surrounded by ring of single larger cells; remainder of surface with longitudinal ribs of which 17–20 attain edge of micropylar area, branching immediately below it either once or twice and forming 35–40 ribs near base of egg; these are crossed by minute transverse ribbing. Diameter, 1 mm.

Stage I. Head pale brown, mouth parts whitish. Body smooth, pale gray-green shading into purplish laterally with 3 pale waved lateral lines; prothorax, anal plates and plates on sides of prolegs gray-brown; tubercles minute black with small setæ. Beneath pale with the usual dark central blotches. Length, 5 mm.

Stage II. Head red-brown, paler towards front, mottled. Body smooth pale greenish brown, paler than in preceding stage, shading laterally into purplish, this color especially marked above prolegs forming more or less evident blotches; three pale lateral lines as before. Tubercles small, black, larger posteriorly. In later stage of growth a pale irregular dorsal band with diamond patches is visible and there are traces of a transverse reddish wart on 5th abdominal segment. Length 10 mm.

Stage III. Head pale in front, cheeks mottled with brownish with blackish curved lateral line. Body light-brown, pale dorsal irregular band bordered by dark lines and with the usual diamond-shaped enlargements; the three pale lines of earlier stages have broadened into irregular pale reddish bands, defined and bordered by dark lines; a transverse black wart across the rear of 5th abdominal

segment with slight central reddish portion; lateral black shading on 5th and 6th abdominal segments extending down over prolegs; a black lunate mark on rear of 8th segment dorsally; tubercles red-brown. Beneath whitish with black patches. Length, 20 mm.

Stage IV. Head pale, apex of lobes orange, this color extending downward to the region of the ocelli, the whole frontal area bordered by an encircling black band. Body smooth, slender, pale purple-brown with orange tubercles of which II is the largest, especially on the rear segments; dorsal stripe of previous stage shows strong central brown marbling; the lateral stripes are more or less lost in the brown marbling which is responsible for the general body-color, traces of the defining darker lines may be found in longitudinal rows of dark dots; a prominent pale orange transverse wart with brown basal shading on 5th abdominal segment; laterad to this orange brown shading extends obliquely backward over rear portion of 5th and front portion of 6th segments; prolegs pale ochreous, shaded with brown on the contiguous sides; claspers bordered inwardly with blackish; lunate mark on 8th abdominal segment orange-brown bordered posteriorly with blackish; tubercles prominently orange; spiracles situated in a pale area, black rimmed. Length, 35 mm.

Stage V. Very similar to the preceding stage. Color pale brown. The lateral oblique patch of brown on 5th and 6th abdominal segments has almost disappeared, when present it is a pale suffused brown, scarcely deeper than the ground-color, crossed by slightly darker shade-lines; filaments whitish. Length, 55 mm.

Food-plant: Willow.

We received a large number of ova laid by typical *faustina* and the forms *diantha*, *verecunda* and *zillah*. The species seems quite difficult to breed and we had success only with those larvæ which hatched earliest and were fed on willow-catkins; the parent of these was a ♀ *diantha* and the resulting progeny was about equally divided between *diantha* and *verecunda;* larvæ of the other forms attained maturity in numbers but died before pupation; we could see nothing in the larvæ to warrant the supposition that *faustina* is distinct from *verecunda* as a species; the eggs hatch over a very extended period and when the first imagines appeared in June we still had young larvæ in the first stage.

Catocala californica Edw.

Ovum. Not distinguishable from that of *C. faustina*, deep purple-brown blotched apically with yellowish and with a yellowish central band.

Stage I. Head pale brown; body dark greenish with three pale lateral stripes; scarcely to be distinguished from that of *faustina*. Length, 5 mm.

Stage II. Head pale, very strongly marked with black. Body greenish-black, deepening in color posteriorly, with pale broad irregularly edged dorsal stripe and three pale waved lateral lines; small black transverse wart on 5th abdominal

segment almost hidden in the ground-color; tubercles small, black; prolegs pale. Beneath pale with the usual central blotches. Length, 11 mm.

Stage III. Head pale, lobes tipped with orange apically, marbled with brown in front and bordered by a deep brown lateral line. Body pale greenish-brown, paler dorsally; dorsal stripe with central dark line; three lateral pale waved stripes bordered with dark brown; tubercles more or less orange; transverse wart of 5th abdominal segment mostly velvety-black, tipped with orange, with strong lateral and posterior black shading extending down over prolegs of 5th and 6th segments; tubercles II of 8th abdominal segment conical with black lunate mark posterior to them. Length, 18 mm.

Stage IV. Head with the apical orange shading more extended, front of lobes marbled with pale brown with strong lateral black encircling band. Body pale purplish-gray; a rather vague pale dorsal stripe with diamond-shaped enlargements and central dark line; the three lateral stripes indistinct with the border lines broken up into a series of dots; tubercles orange, tubercle II being more prominent than in *faustina;* a prominent transverse wart on 5th abdominal segment, orange, blackish at base, with black-brown shading extending obliquely laterally as far as the prolegs, much more distinct than in *faustina*, 8th abdominal segment with conical tubercles dorsally and lunate black-brown mark as before. Length, 26 mm.

Stage V. Head purplish in front, marbled with paler, with diffuse orange shading apically and broad black encircling line laterally extending downward to mouth parts; clypeus outlined basally with black with blackish central mark. Body purplish-brown heavily mottled with black-brown dots; paler dorsal stripe with diamond patches as before; three lateral pale stripes more or less traceable; tubercles reddish orange, paler laterally; tubercle II prominent, marked posteriorly with black especially on 5th and 7th abdominal segments; prominent wart on 5th abdominal segment, reddish orange, marbled with brown; brown lateral oblique patch as before, crossed by a purple-brown spiracular stripe, above which is some diffuse purplish shading and below which a purplish line extending down over the 3rd and 4th pairs of prolegs; lunate black dorsal mark on 8th abdominal segment usually distinct, extending laterally to spiracles, these latter ochreous, black rimmed; legs and prolegs purplish with ochreous shading, filaments whitish. Beneath whitish tinged with pink with the usual central blotches. Length, 60 mm.

Food-plant: Willow.

The larvæ are very closely allied to those of *faustina* but may be distinguished in early stages by the darker coloration and in the final stage by the much greater prominence of the lateral dark patch on 5th abdominal segment. We were not very successful with the brood, only bringing a few to the imaginal state; these all showed the prominent waved white subterminal line and some white patches in the cell.

Catocala irene Behr.

Ovum. Similar to that of *C. californica* and *faustina.*

Stage I. Scarcely to be distinguished from *faustina;* head pale red-brown; body greenish-gray shading into purplish laterally with three pale lines of ground color. Length, 5 mm.

Stage II. Head whitish, marbled with blackish stripes, with slight tinge of orange apically. Body pale gray-green, laterally greenish-black with three pale waved stripes; a faint dorsal stripe with diamond-shaped enlargements. Length, 11 mm.

Stage III. Head pale with brown marbling, shaded with orange at apex and with black lateral border-lines not meeting dorsally. Body light olive-brown with pale dorsal and lateral stripes as before bordered with deep brown, the lower border of stripe II and the upper one of III especially prominent; transverse wart on 5th abdominal segment reddish with ochreous apex; below the wart a black-brown lateral shade broken by the pale stripes, deepest in color above stripe III and tending to extend along its dorsal margin towards anal segment; dorsal tubercles orange, larger and conical on 8th abdominal segment with slight black lunate marks behind them not meeting dorsally. Length, 17 mm.

Food-plant: Willow.

We were unsuccessful in bringing the larvæ to maturity. They are evidently also allied closely to *faustina.*

THE DISTRIBUTION OF SOME SPECIES OF DROSOPHILA.

By Charles W. Johnson,
Boston Society of Natural History, Boston, Mass.

In making a careful faunal survey of any given area, covering a number of years, the gradual or sudden appearance of a species common in other sections, is often of greater importance from the standpoint of geographical distribution than the capture of a number of rare species, often widely distributed, but of whose life history or of the factors governing their distribution little is known.

During the early fall, while experimenting with various species of fungi in an effort to breed some Platypezidæ, my attention was called to several dark colored flies which alighted repeatedly on the netting of many of the jars containing decayed fungi. On capturing several of these I was surprised to see *Drosophila repleta* Woll. (*D. punctata* Loew), the first I had seen in Boston. I had

taken several specimens of this Southern species in Philadelphia, in 1898, had received it from Providence, R. I., in 1904 and from Fall River, Mass., in 1905. Recently Dr. E. P. Felt recorded the species as having been taken in New York City and also at Albany in September and October, 1908.

Another species which appeared later (October 15–20) in large numbers in the same jars of fungi, was *D. busckii* Coq., a species described from the District of Columbia, West Virginia and Illinois in 1901. In 1908 Mr. Wm. Reiff obtained this species from his breeding cages at Forest Hills, Mass., and in 1912, Mr. P. W. Whiting also obtained it at the same locality on decayed meat, while breeding Lucilia.

It seems hardly possible that these social flies could have escaped detection if they had been here in numbers for any length of time, nor is it likely that they have been introduced suddenly by commerce, although the fruit trade may have aided in the wide distribution of *D. repleta* throughout the United States, as recorded by Mr. Frederick Knab in Psyche Vol. XIX, June, 1912.

The corresponding distribution of *D. repleta* and *D. melanogaster* Meig. (*D. ampelophila* Loew) and the fact that in America both were first described from Cuba, seem to point conclusively to similar lines of dispersal. In 1862, Loew described *D. ampelophila* and in a note says: "*Drosophila ampelophila* is very frequent in the Southern regions of Europe, nor is it entirely wanting to middle Europe; it also inhabits the Southern parts of Africa." [*Translation.*]

Meigen in 1830 had described the form with blackish abdomen from Europe as *D. melanogaster* and the same form was described by Zetterstedt in 1847 as *D. nigriventris.* In 1875, Rondani described the yellow form from Italy as *D. uvarum.*

From the time of Loew's description in 1862 until about 1879, there seems to be no record in America bearing positively on this species. Then a number of articles were published indicating that their appearance in great numbers was evidently not a common occurrence. In the Canadian Entomologist, Vol. 14, p. 101, 1882, G. G. Bowles of Montreal says: "In August of 1879, I met with a small dipterous fly, *Drosophila ampelophila* Loew, in considerable numbers." In the same Journal, page 138, 1882, Dr. W. S. Williston says: "In the Autumn of 1879, I bred and recognized

numerous specimens of *Drosophila ampelophila* Loew, at New Haven, from decaying pears, and labelled specimens bearing date of October 30. Since then I have observed them in August, September and October in the greatest abundance in Massachusetts and Connecticut." After quoting the above note by Loew on its distribution he says: "The question is an interesting one: In which continent is it a native?"

Lintner, in his first annual report, 1882, page 216, says, in referring to some small flies that were sent to him, "They proved to be identical with numerous specimens of *Drosophila ampelophila* in my collection, having the memorandum of "bred from a jar of pickled plums, September, 1875." Comstock, in the Report of the Department of Agriculture 1881–1882, describes and figures its life history.

The question to be considered now is, did this species occur in the Northern States during Say's, Harris' or Fitch's time, or has it worked northward since then? Say might have overlooked it, but for Harris, and especially Fitch—who described so many minute diptera, to have entirely ignored this species, seems improbable.

To return to *D. repleta* whose dispersal throughout the United States is so fully recorded. This was described by Loew from Cuba in 1862 as *D. punctulata*. It had, however, been previously described from Madeira by Wollaston in 1858. In 1886, Mik described the same species as *D. aspersa* from Vienna, Austria and Ashanti, W. Africa. The more gradual and recent dispersal of *D. repleta* would indicate that it was not indigenous to America and that it undoubtedly appeared first in the West Indies. There is no evidence to dispute the fact that *D. melanogaster* might also have appeared first in the West Indies and being more prolific, has spread with greater rapidity.

I think we can thus reasonably consider the Eastern Continent as the original habitat of the two species and that they have been introduced either by vessels sailing from Southern Europe during the Spanish régime or from Western Africa during the slave trade. There is another fly that is supposed to have been introduced in this manner. Osten Sacken, in describing *Borborus venalicius* (Cat. of Diptera, p. 263, 1878), from Cuba, says: "Dr. Loew informs me that this is an African species; and as I found it abun-

dantly in Cuba, it seems probable that it was brought over in slave ships." This species has also spread northward into Florida and Bermuda and southward to Brazil.

NOTE ON TWO PREOCCUPIED MUSCID NAMES.

In the April issue of Psyche I published a synopsis of the Sapromyzidæ in which on page 58 was described a new genus of Sciomyzidæ under the name *Poecilomyia*. Hendel (Genera Insectorum, Richardiinæ, p. 24, 1911), has previously used this name, hence I propose to change it to *Poecilographa*. In the same paper, on page 73, I described a *Minettia annulata*, overlooking Becker's *Lauxania annulata* (Ztschr. Hym. Dipt., 1907, 383). In as much as the present tendency is to consider *Minettia* as a subgenus of *Lauxania* the preoccupied name may be changed to *annularis*.

A. L. Melander.

BOOK REVIEW.

Seitz, Adalbert. The Macrolepidoptera of the World. To be completed in 16 volumes containing about 485 parts, of which two complete volumes and numerous parts have been issued. Stuttgart, Verlag des Seitzschen Werkes (Alfred Kernen) 1906.

This elaborate compendium of the larger Lepidoptera, undertaken by Professor Seitz in 1906, has now reached the stage that its completion within a reasonable time seems to be assured. A large number of fascicles have been issued by Seitz and his various collaborators, who include, Aurivillius Bartel, Eiffinger, Fruhstorfer, Grünberg, Haensch, Janet, Jordan, Mabille, Pfitzner, Prout, Röber, Rothschild, Standfuss, South, Strand, Warren and Weymer.

The main feature of the work is a large series of beautifully executed, colored plates, which according to estimate will number about one thousand in the completed set. All which the reviewer has seen are of very exceptional quality in spite of the low price at which they are sold. The letter-press includes descriptions of genera and higher groups as well as of species and these seem on the whole to be fairly complete, although occasionally the specific descriptions drift into a running commentary on the illustrations. Considering, however, the enormous mass of material to be dealt with, the authors are to be congratulated on avoiding this latter condition to a very great extent. Taken together, the text and figures should make it a comparatively simple matter for any one to identify a large proportion of the species that are described and figured. To facilitate this process, the faunæ of the different zoölogical regions have been grouped into four independent series dealing with the Palæarctic, American, Indo-australian and African faunæ respectively. Each is to be complete in itself as a set of four volumes and an additional 17th volume to contain general matter on structure, biology and distribution is promised.

Lepidopterists as well as amateur collectors throughout the world will be very fortunate to have such a generally complete cyclopædic account of the larger butterflies and moths. C. T. B.

EXCHANGE COLUMN.

Wanted, in exchange or for cash, North American Catocala.—Rudolph C. B. Bartsch, 46 Guernsey Street, Roslindale, Mass.

Empididæ desired from any part of the world.—A. L. Melander, Bussey Institution, Forest Hills, Mass.

Will name and return species in certain families of Coleoptera. Buprestidæ especially desired.—C. A. Frost, 26 Pond Street, South Framingham, Mass.

Wanted. Insects from ant-nests, with specimens of the ants, from any part of the world. Will give Coleoptera, Diptera and Hymenoptera from the Western United States.—W. M. Mann, Bussey Institution, Forest Hills, Mass.

Will exchange for Geometridæ from any section of North America, or identify material for privilege of retaining examples.—L. W. Swett, 501 Washington Street, Room 44, Boston, Mass.

Will exchange insects of various orders for Parsitic Hymenoptera from any part of the world.—C. T. Brues, Bussey Institution, Forest Hills, Mass.

Wanted, for cash or exchange, living material of Lucilia from the Southern States; also living material of *Cynomia mortuorum* from Europe and any other species of Cynomia except *Cadaverina*. Will give directions for shipment.—P. W. Whiting, Bussey Institution, Forest Hills, Mass.

Carabus chamissonis and other rare Coleoptera for Dytisidæ not in my collection. —F. W. Dodge, Melrose Highlands, Mass.

Wanted. Ants from all parts of the world.—W. M. Wheeler, Bussey Institution. Forest Hills, Mass.

I pay cash or give American and exotic insects in exchange for fertile eggs of Catocala spp., *living* Cataocla ♀ ♀ (captured specimens only), hibernating pupæ and larvæ of any other group of Lepidoptera.—William Reiff, 366 Arborway, Jamaica Plain, Boston, Mass.

Numbers of American Museum Journal Desired. Vol. III, No. 4. Vol. V, Nos. 1, 2 (including Guide leaflet 18), and 3.—Nathaniel T. Kidder, Milton, Mass.

Florida insects of all orders, also Fish, Batrachians, Reptiles, Shells and Marine Invertebrates sold by A. G. Reynolds, Gulfport, Florida.

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